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PATENT SPECIFICATION

NO DRAWINGS

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COMPLETE SPECIFICATION

Regenerators for Industrial Furnaces

We, OSTERREICHISCH - AMERIKANISCHE MAGNESIT AKTIENGESELLSCHAFT, of Radenthein, Carinthia, Austria, a body corporate organised under the Laws of Austria, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a regenerator for an industrial furnace, particularly a tank furnace used in the manufacture of glass, which comprises magnesia bricks.

It is already known to use basic brick, such as magnesia or chrome-magnesia bricks, for lining regenerators or checker-work of industrial furnaces, such as open-hearth furnaces. The magnesia bricks previously used for this purpose, however, do not have a particularly high resistance to temperature cycles and an increase of their thermal shock resistance can be achieved, as a rule, only by an addition of foreign matter, such as alumina, which usually reduces the refractoriness-under-load. Besides, magnesia bricks which have not been impregnated before use may suffer hydration at temperatures of about 100° C. and it has recently been found that this hydration may cause a premature destruction of the brick in regenerators. An impregnation for protection against hydration may be obtained by treating the finished, fired brick with gaseous carbon dioxide or other acid gases, or subjecting them to the action of solutions of salts which react with magnesia with hardening, such as salts of magnesium, zinc, manganese, iron, aluminium or chromium. Furthermore a process of manufacturing basic bricks and masses based on magnesia, i.e. refractory materials containing a major amount of magnesia, and other basic materials, particularly magnesia bricks, which are resistant to disintegration under the action of dicalcium silicate, has been described, in which stabilizers for dicalcium silicate are used and the bricks or masses are soaked in or sprayed with a solution of the stabilizing agents after firing and are then dried. The stabilizers may consist of boron compounds and in this case the B_2O_3 content of the brick or compositions after drying should be as high as possible and amount to at least 0.6 to 1%. This process may also be applied further to brick or masses based on magnesia and containing the stabilizers in the refractory batch, i.e. the mixture of refractory materials, any binding agents, and, if desired, liquids, such as water from which the refractory bricks or masses are made in conventional manner. It has also been proposed to manufacture a synthetic magnesia refractory material, which comprises a magnesium oxide crystal structure, in which a substantial part of the surface of the crystals is free from a film of impurities and the remaining impurities are separated into more or less discrete and discontinuous zones, which are generally smaller than and do not enclose the magnesia crystals (U.S. Patent Specification 2,571,101). This magnesia material is dense and non-fused and contains at least 95% of magnesium oxide and not more than 2.0% silica and is obtained, e.g., by firing the starting material together with small amounts of compounds of titanium, vanadium, chromium, manganese or iron. If this material contains boron compounds, which are considered an undesirable impurity, their amount, calculated as B_2O_3, should not exceed 0.5%. Finally, a process of manufacturing refractory magnesia brick has been proposed in the Specification of Application No. 21,483 of 1900, in which burnt magnesia and a fusible boron compound are mixed with an addition of water, whereafter the shaped bodies are fired at a high temperature. The fusible boron compound used is, e.g. boron oxide or boric acid. In a process of this kind the boron com-

pound may be added in an amount of about 2% in the case of magnesia having a small lime content and in an amount of up to 12% in the case of magnesia containing a substantial amount of lime. In this process, however, the content of B_2O_3 is fairly high so that the refractoriness-under-load of the brick is unsatisfactory.

According to the present invention there is provided a regenerator for an industrial furnace, particularly a tank furnace, comprising magnesia bricks, containing 0.1 to 0.5% of one or more boron compounds, calculated as B_2O_3, to render the brick resistant to hydration.

The boron compounds are preferably introduced by mixing with the refractory batch, from which the refractory bricks may be made in conventional manner, and are preferably not introduced into the bricks by impregnating. In this connection it may be mentioned that with the usual impregnating methods, in which finished bricks are treated with boron-containing solutions for stabilization against disintegration due to the action of dicalcium silicate, only about 75% of the void space of the brick is filled with the impregnating solution. In view of the relatively low solubility of the boron compounds suitable for impregnation, such as boric acid or mixtures of boric acid and borax, it is not possible, therefore, to introduce B_2O_3 into very dense brick in amounts sufficient to render the brick sufficiently resistant to hydration.

To ensure that impregnated bricks will resist hydration even when they have been subjected to a temperature of about 1550° C., about 0.4% of B_2O_3 must be used, whereas when the boron compounds are added to the refractory batch, an amount of, on the average, 0.25% B_2O_3 is sufficient for this purpose.

The simplest way of manufacturing the regenerator brick of the invention is to use a sintered magnesia which has been obtained by sintering magnesia with an addition of the required amounts of boron compounds and/or to add the desired amounts of boron compounds, such as boric acid, alkaline earth metal borates or borax, to the already sintered magnesia, which is used as starting material, before it is shaped. The sintered magnesia may be obtained from natural magnesia or from compounds which yield magnesia when being burnt, such as brucite or synthetic hydroxide or carbonate of magnesium. It is surprising that a relatively small addition of boron compounds without any other addition will result in magnesia bricks which have proved eminently satisfactory when used in regenerators and checkerwork. It is particularly suitable to use the regenerator bricks in a fired condition. It is emphasized, however, that even with chemically bonded, i.e. unfired brick, an addition of boron compounds, particularly boric acid, to the refractory batch will result in resistance to hydration, and this resistance is retained when the chemical bond has ceased to exist and is being replaced by a ceramic bond, as is e.g. the case at a temperature of about 1000° C. with a kieserite (magnesium sulphate) bond.

If, in an industrial regenerator of the invention, the bricks are assembled in an un-fired condition, the first use of the regenerator will heat the bricks, the innermost ends of the bricks being raised to a higher temperature than the outer ends. The innermost ends may be heated to a temperature where the chemical bond is destroyed and replaced by a ceramic bond, whilst the outermost ends remain below the temperature of destruction of the chemical bond. Hence there will be a temperature zone in the bricks where the chemical bond has been destroyed but not replaced by a ceramic bond. Whilst this zone is a potential source of danger to bricks, in a regenerator of the invention the bricks are safeguarded in that they maintain a resistance to hydration in the zone.

The regenerator bricks have a good thermal shock resistance. They pass the usual test consisting of a plurality of cycles comprising heating to 950° C. followed by cooling to 100° C. They resist the action of moist gases (resistance to hydration) irrespective of the height of the temperature to which they have previously been exposed. In view of the fact that the addition of boron compounds is too small to adversely affect the refractoriness-under-load, the refractoriness-under-load of the brick must be designated as very good. This maintenance of a high refractoriness-under-load ensures that the brick, even when used in grate checkerworks, will neither sag nor crack.

WHAT WE CLAIM IS:—

1). A regenerator for an industrial furnace, particularly a tank furnace, comprising magnesia bricks containing 0.1 to 0.5% of one or more boron compounds, calculated as B_2O_3, to render the brick resistant to hydration.

2). A regenerator as claimed in Claim 1, wherein the boron compound(s) is (are) introduced by mixing with the refractory batch from which the bricks are made.

3). A regenerator as claimed in Claim 1 or Claim 2, wherein the magnesia bricks are burned bricks.

4). A regenerator for an industrial furnace, particularly a tank furnace, substantially as hereinbefore described.

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